Remarks

Preliminary Matters

Claims 1- 4, 6, 8-10, 13, and 14-18 are pending. Claims 7 and 14 were cancelled.

No additional fees are required. If determined otherwise, the Office is authorized to charge Deposit Account No. 07-1077 for the amount.

The Office has commented about "microreplicated" being a process limitation. Applicant traverses this view, because the adjective "microreplicated" describes the faithful repeated reproduction of the etched pattern by design, not be happenstance.

Withdrawal of Non-Compliant Amendment

Applicant acknowledges the withdrawal of the Notice of Non-Compliant Amendment, with thanks.

Amendment to Specification

Applicant acknowledges the entry of amendments to the specification, with thanks.

Withdrawn Rejections

Applicant acknowledges the withdrawal of prior rejections, with thanks.

Objection to Specification

Notwithstanding the entry of the amendments to the specification, the specification amendments were objected to as constituting new matter. The text in the new paragraphs added after page 5, line 4 are taken, word-for-word, from United States Patent Application Serial No. 09/480,955, one of the applications incorporated by reference in the paragraph of the specification bridging pages 4 and 5. That application issued as U.S. Pat. No. 6,524,694. The text incorporated appears at Col. 4, lines 31-67 and Col. 5, lines 1-67. The cover page and those Columns 4 and 5 of Patent '694 are provided with this response.

§ 112 Rejection

Claims 1-4, 6-10, 13-18 were rejected because "thermoplastic resin" lacked antecedent basis in Claim 1. That has been fixed by amending Claim 1, with support from Claim 3 and Page 3, lines 27-30 and Page 4, lines 1-7 and 28-30.

§ 102 Rejection using U.S. Pat. No. 4,370,368

Claims 1, 4, 6, 13, and 16-18 were rejected using Patent '368. To advance prosecution, Applicant has imported the subject matter of Claim 7 into Claim 1, from which all other claims depend directly or indirectly. Claim 7 has been cancelled. Claims 1, 4, 6, 13, and 16-18 now overcome this §102 rejection.

§ 102 Rejection using U.S. Pat. No. 5,384,173

Claims 1-3, 6-10, 13, 14, and 16-18 were rejected using Patent '173. Applicant traverses this rejection for two very important reasons:

(1) Claim 1 pending requires the claimed product to have **an *outer* surface having a matte finish with an etched pattern**. Patent '173 **does not** teach or suggest a matte finish on the **outer surface.** Please see Col. 1, lines 46-51 of Patent '173, conveniently reproduced here:

> The present invention provides a container for a photographic film which has achieved the above object, comprising a container body being made of a thermoplastic resin having a roughened face 0.001 to 5 μm in height of roughness on the inner peripheral wall portion.

Patent '173 requires the roughness to be "on the inner peripheral wall" of the container body. Such roughness makes sense for the invention of Patent '173, because the purpose of the invention is to reduce the occurrence of a bursting pop sound, a bottom sink mark, or buckling. These problems existed in the art of making photo film containers and slowed the production cycle. See Col. 1, lines 7-25 and 39-45 of Patent '173.

Applicant is not concerned at all with the inside surface of his molded product. ***Applicant wants a matte finish on the outer surface*** of his claimed molded thermoplastic product. To emphasize this point, a phrase from Claim 14 was imported into Claim 1 that the etched pattern adds tactile texture to the claimed product. Tactile texture on the outer surface is totally different from roughened inner walls. All pending claims are novel and patentable over Patent '173.

(2) Claim 1 requires **light-diffusing particles**. Patent '173 requires "light-shielding" material to be added to the compound. Please see Col. 11, lines 38-42 of Patent '173, which *defines* light-shielding ability to be opacity, conveniently reproduced here:

> To the container for a photographic film of the invention, light-shielding material may be added in order to improve printability, rigidity, light-shielding ability (opacity), physical strength, particularly dropping impact strength or the like.
>
> Representative examples of the light-shielding material is shown below.

Patent '173 *needs opacity* because a photo film container that lets in light will expose the un-shot film in the container.

Applicant's invention is built on the concept of diffused translucency. ***Applicant wants a diffused translucency*** for his claimed molded product. To emphasize this point, another phrase from Claim 14 was imported into Claim 1 that the frost colorant comprises light-diffusing particles to add diffused translucency to the product. Diffused translucency of a molded thermoplastic product is totally different from opacity for a photo film container by necessity to protect light-sensitive film in that photo film container. All pending claims are novel and patentable over Patent '173 for this reason also.

§103 Rejection

Claim 15 was rejected using Patent '173 because of optimization of particle size. As mentioned above, Patent '173 wants an opaque product, whereas Applicant wants a diffusely translucent product. Particle size does play a role in the selection of Applicant's frost colorant. But no one in the art would look to Patent '173 that demands opacity for its photo film container.

Conclusion

Applicant has overcome numerous references and is entitled to a Notice of Allowance for his claimed invention, a combination of an etched pattern on the outer surface of the molded thermoplastic product and a frost colorant of light-diffusing particles within the molded thermoplastic product.

As stated previously, Applicant combines precise etching to the physical outer surface with a chemical additive of light-diffusing particles to the bulk of the composition of the product to achieve his inventive effect.

If there are any matters that prevent a Notice of Allowance, the Examiner is invited to contact the undersigned by telephone.

Respectfully submitted by:

July 5, 2007
Date

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(12) **United States Patent**
Phillips

(10) **Patent No.: US 6,524,694 B1**
(45) **Date of Patent: Feb. 25, 2003**

(54) **COMPOSITIONS FOR IMPARTING A TRANSLUCENT OPTICAL EFFECT TO TRANSPARENT THERMOPLASTIC POLYMERS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/480,955**

(22) Filed: **~~Jan. 11, 2000~~**

Related U.S. Application Data

(63) Continuation-in-part of application No. 08/876,003, filed on Jun. 13, 1997, now abandoned.

(51) **Int. Cl.**[7] **B32B 5/02**

(52) **U.S. Cl.** **428/323**; 524/404

(58) **Field of Search** 428/323, 332, 428/324, 325, 328, 330, 331, 329; 264/211; 524/239, 261, 275, 277, 313, 318, 404, 413, 423, 424, 425, 430, 447, 449, 451, 493; 362/812

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(57) **ABSTRACT**

The invention provides compositions and methods for imparting a translucent optical effect to transparent thermoplastic polymers. The compositions comprise the thermoplastic polymer and 0.01 to 15 parts per hundred by weight (preferably 0.1 to 6, more preferably 0.2 to 5 parts by weight, even more preferably 0.5 to 2 parts by weight, and most preferably 0.5 to 1.5 parts by weight) of at least one particulate, light diffusing material in the form of powders, fibers, whiskers, platelets, flakes, aggregates, agglomerates, and mixtures of these, comprising a average maximum particle size of from about 0.1 microns to about 200 microns (preferably from about 1 to about 100 microns). A first embodiment of the invention comprises a one step method for imparting the translucent optical effect. A second embodiment comprises a two step method, including the use of a concentrate composition. The translucent optical effects are obtainable in a continuum of very smooth to very grainy, depending on the type and concentration of the particles employed.

12 Claims, No Drawings

aggregates, agglomerates and mixtures of these. Preferably, the particulate material is selected from the group consisting essentially of calcium sulfates, talc, silicates, kaolin, silicas, mica flakes, mica platelets, mica pearls, titanates, metal sulfates, metal carbonates, sulfides, metal oxides, borides, wollastonite, basalt, boron, boron nitrides, ceramics, naturally occurring calcium carbonates, and mixtures of the foregoing. If the particulate material is boron nitride, it is preferably in the form of for example, powders, aggregates, agglomerates, and the like, or mixtures of these.

In another embodiment of the invention, a two-step method is employed that comprises the steps of forming a concentrate composition which comprises a mixture of (i) 40 to 90 parts by weight of a carrier agent selected from the group consisting of a first transparent thermoplastic polymer, a dispersing agent, and mixtures of these, and (ii) 10 to 60 parts by weight of at least one particulate, light-diffusing material having an average maximum particle size of about 0.1 to 200 microns, preferably about 1 to about 100 microns, as described above. If a mixture of the first polymer and the dispersing agent is employed, the mixture preferably comprises 80 to 98 parts by weight of the first polymer and 2 to 20 parts by weight of the dispersing agent. The carrier agent is preferably finely ground, finely flaked, finely pelletized or a mixture of these, and, more preferably is finely ground. For purposes of this invention, finely ground means a size of about 10 mesh or finer, preferably about 20 mesh; finely flaked means a maximum dimension of about ½ inch or less, preferably a maximum dimension of about ¼ inch or less; and finely pelletized means a maximum diameter of about ⅛ inch or less, preferably a maximum diameter of about 1/16 inch or less. The concentrate, in an amount of 0.1 to 15 parts by weight, is then mixed with 85 to 99.9 parts by weight of a second transparent thermoplastic polymer that is chemically compatible with the carrier agent, to form a second mixture which is then molded, extruded or formed by conventional means to form the translucent polymer product. The first and second transparent thermoplastic polymers may be the same or different and are selected from the group described above. The method may optionally include a further step in which the concentrate is extruded and pelletized before adding it to the second polymer.

By either the one-step method or the two-step method, the resulting translucent polymer product comprises 0.01 to 15 parts by weight of the total particulate material and exhibits an average translucency having a measured transmittance that is about 2% to about 65% lower than the transmittance of a polymer part comprising the polymer alone; a haze that is about 900% to about 11,400% higher than the haze of a polymer part comprising the polymer alone; and a clarity that is about 7% to about 95% lower than the clarity of a polymer part comprising the polymer alone, all at a molded part thickness of 30 mils.

DETAILED DESCRIPTION OF THE INVENTION

A translucent frosted glass effect in transparent thermoplastic molded, extruded or formed polymer products is obtained by the methods and compositions of the invention. The compositions and methods may be employed to impart a translucent optical effect to virtually any transparent or near transparent grade of thermoplastic polymer including, but not limited to, polyolefins (including, but not limited to polypropylene, polyethylene and clarified grades thereof), polyethylene terephthalate, glycol-modified polyethylene terephthalate, glycol-modified polycyclohexanemethanol terephthalate, acid-modified polycyclohexanemethanol terephthalate, polystyrene, styrene acrylonitrile copolymers, polystyrenebutadiene, polystyreneacrylic ester, acrylonitrile-butadiene-styrene, acrylonitrile-styrene-acrylic ester, acrylics, polymethacrylonitrile, polyethylenemethylacrylate, polymethylmethacrylate, polyethylene-ethylacrylate, polyethylenebutylacrylate, polyethyleneacrylic ester, cellulose butyrate, polymethylpentene, polyisobutene, polybutene, polyamides, polycarbonate, ionomers, polyurethane, liquid crystal polymers, cellulose propionate, polyvinyl alcohol, polyethylenevinylalcohol, polyethylenevinylacetate, polyvinyl chloride, high density polyethylene, polypropylene, polyacetal, and copolymers, grafts and blends of the foregoing.

The frosted glass effect may be a visual effect only, such as that obtained when a composition of the invention is extruded, formed, or produced in a mold having a smooth surface, to produce a smooth-surfaced translucent product. Alternatively, the effect may be both visual and tactile, such as that obtained by molding the composition of the invention in a mold having a textured surface to impart a matte finish to the translucent product. As described further below, transparent or semitransparent color concentrates, pigments or dyes may also be blended with the invention compositions to produce colored translucent products, such as a "pink frost", a "green frost", a "lavender frost" etc., in addition to a "clear" or "natural" frosted product. Suitable organic pigments, inorganic pigments and polymer-compatible dyes are known to those skilled in the art of making colored polymers.

The translucent optical effects imparted by the compositions and methods of the invention are achieved by mixing very small quantities of light-diffusing particles, having an average maximum particle size of about 0.1 to about 200 microns, preferably about 1 to about 100 microns, with a transparent thermoplastic polymer prior to molding or extruding the mixture. Preferably, the particles are selected on the basis of their ability to reflect and transmit light diffusely, rather than rectilinearly or specularly, and the translucent visual effect more closely resembles a matte finished molded or spray-coated product. Thus, for example, light-diffusing materials, such as non-shiny mica particles used for laser marking, are preferred over light reflecting (specular) materials, such as mica pearls. However, mica pearls may also be employed to achieve a frosted effect with a more "satin" appearance.

To achieve the desired frosted effect, the light-diffusing particles may be in any form, such as powders, fibers, whiskers, platelets, flakes, aggregates, agglomerates or mixtures of these. Suitable particles include, but are not limited to, naturally occurring calcium carbonates, including reagent-grade calcium carbonate, ground chalk, ground limestone, ground marble and ground dolomite; ground or fiber calcium sulfates; silicates, such as glass fibers, glass flakes, solid and hollow glass spheres, aluminum silicate, synthetic calcium silicate and zirconium silicate; talc; kaolin; mica flakes, platelets and pearls; natural silicas, such as sand, quartz, quartzite, perlite, tripoli and diatomaceous earth; fumed silicas; titanates, such as barium titanate; sulfates, such as barium sulfate; sulfides, such as zinc sulfide and molybdenum sulfide; metallic oxides, such as aluminum oxide, zinc oxide, beryllium oxide, magnesium oxide, zirconium oxide, antimony oxide, titanium dioxide and aluminum hydroxide; aluminum diboride flakes; inorganic fibers, such as wollastonite, basalt, boron, boron nitrides and ceramic; single crystal fibers (i.e. whiskers), such as those of alumina trihydrate; short fibers, such as those of aluminum

silicate with aluminum and magnesium oxides and calcium sulfate hemihydrate; organic flatting agents, such as wood flour and starch; and mixtures of any of the foregoing. If the particulate material is boron nitride, it is preferably in the form of, for example, powders, aggregates, agglomerates, and the like, or mixtures of these.

A desired translucent optical effect ranging in a continuum from very smooth visual textured effects to very grainy visual textured effects may be achieved, depending on the particulate material or mixture of particulate materials selected and the quantity of the particulate employed. For example, a smooth visual translucency is obtained by using white powder particulates, such as barium sulfate, zinc sulfide or ultrafine ground chalk. Slightly grainy visual translucency is obtained by using transparent particulates, such as solid glass microspheres having a particle diameter of about 2 to about 100 microns (preferably about 4 to about 44 microns) or hollow glass microspheres having a particle diameter of about 10 to 100 microns (preferably about 65 to about 75 microns); whereas a slightly more grainy visual translucency is obtained by using ceramic fibers having a diameter of about 2 to about 12 microns, and lengths of about 45 microns to about 1.5 millimeters (mm). Grainy translucent visual effects are also obtained with additives such as lamellar kaolin having an aspect ratio of 10:1 (length:diameter). To obtain very grainy visual translucent effects, wollastonite having aspect ratios ranging from about 5:1 to 15:1, are employed, with the highest aspect ratios giving the grainiest effects. Very grainy translucent visual effects are also achieved by using whiskers, such as such as those of alumina trihydrate, and metal flakes or platelets, such as those of mica.

Exemplary suitable particles for use in the invention are Sachtleben Blanc Fixe Micro® 2278N (milled barium sulfate, approximately 3 microns, available from Whittaker, Clark & Daniels, Inc., South Plainfield, N.J. (manufacturer Sachtleben, Germany); Omyacarb® 4 (calcium carbonate, 3.5 micron median, 15 micron max, Omya Inc.); Talc 399 (talc (magnesium silicate), available from Whittaker, Clark & Daniels, Inc., South Plainfield, N.J. (manufacturer Specialty Mineral); Zeeospheres® W-610 (ceramic microspheres, mixture of particle sizes of approximately 2 to 45 microns, Zeelan Industries, St. Paul, Minn.); Silcron® G602 (fine particle silica, average particle size approximately 2.7 microns, SCM Pigments, Baltimore, Md.); NYAD G® Wollastocoate (wollastonite, aspect ratio 15:1, 100–325 mesh), NYAD® 400 wollastonite (aspect ratio 5:1), 400 Wollastocoate (aspect ratio 5:1, 400 mesh) (NYCO Minerals, Inc., Willsboro, N.Y.); hollow glass microspheres (glass bubbles, 3M Corporation); Acematt® TS 100 (silica flatting agent, average particle size approximately 2 to 10 microns, Degussa Corp., Ridgefield Park, N.J.); Iriodin®/ Lazer Flair® LS 810 (mica-based additive, particle size approximately 2 to 28 microns, EM Industries, Hawthorne, N.Y.); Afflair® 110 Fine Satin (mica-based additive, E.M. Industries, Hawthorne, N.Y.); Polartherm® (PT110 (Advanced Ceramics Corporation, Cleveland, Ohio; boron nitride particulate material, exhibiting a particle size distribution as follows: 10% of particles 23.770 microns or smaller, 50% of particles 49.920 microns or smaller, and 90% of particles 73.710 microns or smaller); and Carborundum Carbotherm® AS0517 (Carborundum Corporation, Amherst, N.Y.; boron nitride particulate material, agglomerates: approximate particle size 30 microns).

Because the quantities of the particulates employed in the invention compositions and methods are extremely small, the particulates do not perform the traditional functions of fillers (e.g. reinforcers, extenders, opacifiers, plasticizers, etc.).

In one embodiment of the invention, a one-step method for imparting a translucent optical effect to a transparent thermoplastic polymer is employed, and comprises the steps of forming a substantially homogeneous composition comprising a mixture of (i) 0.01 to 15 parts by weight of at least one particulate, light-diffusing material having an average maximum particle size of from about 0.1 microns to about 200 microns, and (ii) 85 to 99.99 parts by weight of a transparent thermoplastic polymer; and molding, extruding or forming the homogeneous mixture to form a translucent molded, extruded or formed polymer product. Preferably the particles have an average maximum size of from about 1 to about 100 microns. Preferably, the mixture comprises 0.1 to 6 parts by weight of the particulate material, more preferably, 0.2 to 5 parts by weight, even more preferably, 0.5 to 2 parts by weight, and most preferably 0.5 to 1.5 parts by weight of the particulate material.

In this embodiment of the invention, to achieve a substantially homogeneous mixture of the particulates and the polymer for a homogeneous translucent optical effect, it is preferred that the polymer be finely ground 20-mesh powder. The pelletized polymer may be finely ground to a 20-mesh powder prior to mixing with the particulates or the polymer may be purchased as a finely ground powder, when available. As discussed further below, a dispersing agent and/or a flow enhancing (anti-bridging) agent may also be added to the particulate mixture to aid in achieving homogeneity. For practical purposes, when mixing large amounts of polymer with particulates, the polymer will not be preground in powder from but may be used in commercially available pellet form (average diameter 1/16 inch to 1/8 inch or greater). The achievable homogeneity of a pelleted polymer/ particulate mixture, however, depends upon such factors as the type of particulate employed, the pellet and particulate diameter or size, the mixing time, the natural segregation of the components during the time period before use, and the like, resulting in a product which may have a variable, rather than a homogeneous, overall translucent appearance. Thus, this embodiment of the composition and method is less preferred if a high degree of homogeneity of the optical effect is desired. Homogeneity of a pelleted polymer/ particulate mixture may be improved by separately metering the polymer pellets and the particulates (frosting agents, and/or dispersants and/or flow enhancers) through separate feed lines into the melting screw portion of any device used during the melt mixing phase of the extruding, molding or forming process.

In another embodiment of the invention, a two-step method is employed. By this method, a substantially homogeneous concentrate mixture comprising at least one particulate material in a carrier agent is prepared. A desired quantity of this concentrate is then blended with a chemically compatible polymer (let down resin) to form a second mixture, which is then molded, extruded or formed and cured, as described above, to form the translucent polymer product. The degree of translucency can be adjusted by increasing or decreasing the loading (i.e. the "let down ratio" of concentrate to let down resin) of the concentrate in the end product.

The two-step method comprises the steps of forming a concentrate composition comprising a mixture of (i) 40 to 90 parts by weight of a carrier agent that is finely ground, finely flaked, finely pelletized, or a mixture of these, selected from the group consisting essentially of a first transparent thermoplastic polymer, a dispersing agent, or mixtures of these, and (ii) 10 to 60 parts by weight of at least one particulate, light-diffusing material as described above, to form a second